Space Weather Technical Forecast

Issued on Monday, 31 October 2022 at 12:56 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Chance of G1/Minor Storms days 1 and 4 (31st Oct and 3rd Nov). Ongoing Active electron fluence.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been low over the last 24 hours, with only minor low C-class flares observed. There are currently three Active Regions on the visible disc. AR3135, is the largest region with well developed leading and trailing spots. AR3131 has since simplified to a single large spot, losing its trailing spots and pores. AR3133 close to centre disc is small and continues to fade. No Earth-directed CMEs have been observed.

Solar Wind / Geomagnetic Activity: The solar wind, observed by DSCOVR at L1, has remained fairly stable, with a slight declining trend from between 550-570 km/s to currently around 450km/s. This is indicative of the waning fast wind of CH37 which we have been connected to during recent days. Density was around average or briefly slightly above. Total interplanetary magnetic field strength was weak below 6nT throughout. The north-south component, Bz, was also weak with values between +4/-4 nT. Phi angle was predominantly positive (Away from the Sun). Geomagnetic activity was Quiet to Unsettled (Kp 2-3).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) as measured at GOES-16 has remained at background levels. High energy electron flux (greater than 2MeV) at GOES-16 was at mostly moderate levels initially, becoming high after midday UTC, with a peak of 3720pfu at 30/1735 UTC. Fluence levels followed a similar trend, becoming Active from 30/2100 UTC, with a peak value of 1.2e8 integrated pfu observed at 31/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is likely to be Low or Very Low, with a slight chance of isolated M-flares.

Solar Wind / Geomagnetic Activity: No Earth-directed CMEs are forecast. The Earth is currently under the influence of the high speed stream from positive coronal hole 37. Later on day 1 (31st), Earth will likely transition into CH38. Speeds of around 500-550 km/s are expected, with a chance of Strong levels (600-650 km/s) for a time, though this is uncertain. Earth will then likely transit out of the fast wind of CH38 early on day 3 (2nd) with a likely decline in wind speeds before the fast wind from CH39 arrives probably late on day 4 (3rd). Geomagnetic activity will likely be Quiet to Unsettled (Kp 2-3) throughout the period, with a chance of Active or G1/Minor Storm intervals (Kp 4-5) late on day 1 (31st) or late on day 4 (3rd) due to the fast wind arrivals of CH38 and CH39 respectively.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10MeV) observed by GOES-16 is expected to be at background levels. High energy electron flux (greater than 2MeV) observed by GOES-16 is forecast to be mostly at high levels, especially during the diurnal maximum on each day. The associated 24 hour electron fluence is expected to continue

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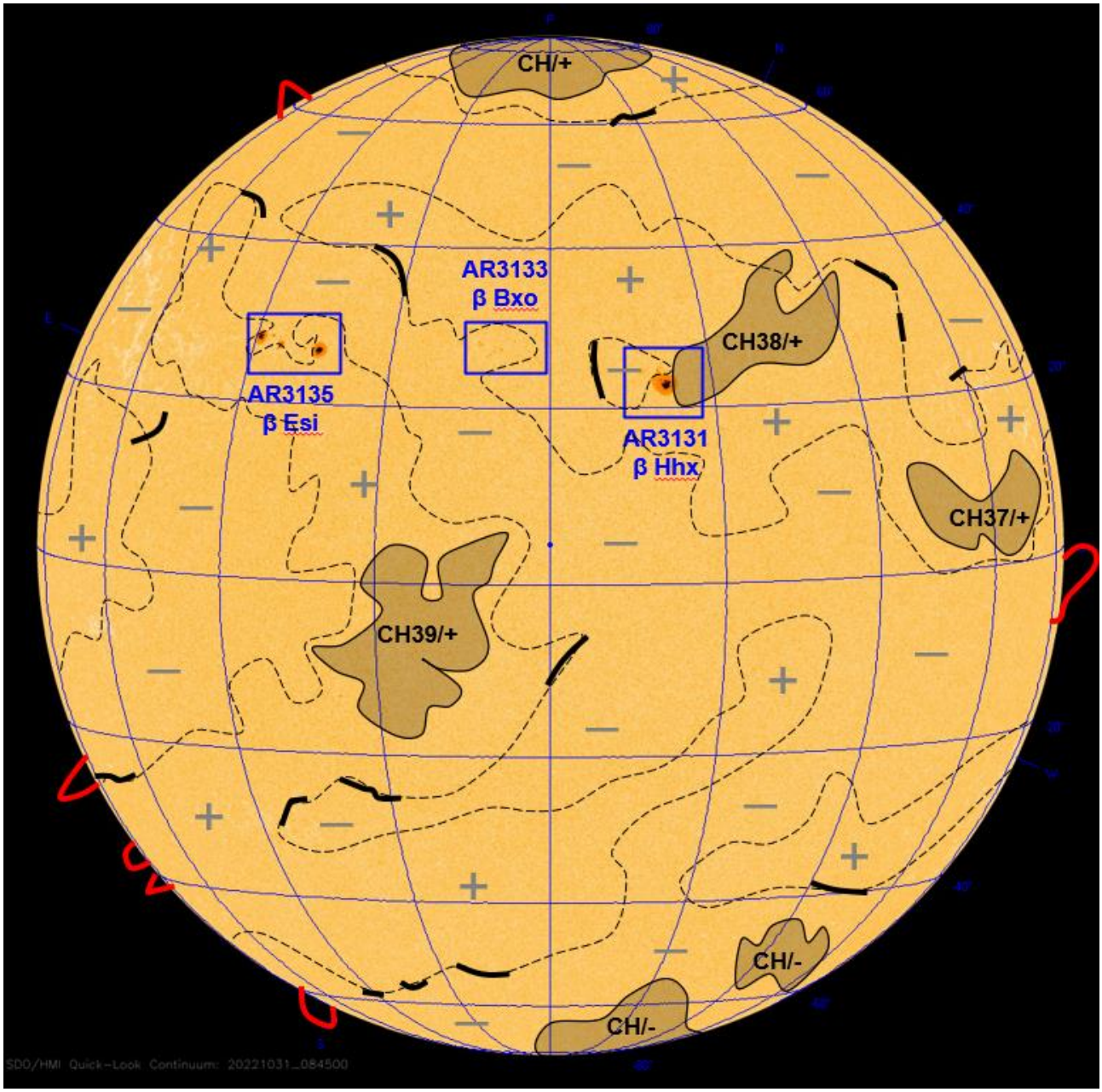
to increase, and likely to remain above the Active (1e8 integrated pfu) threshold.

Figure 1. Solar Analysis Valid 31/0845UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

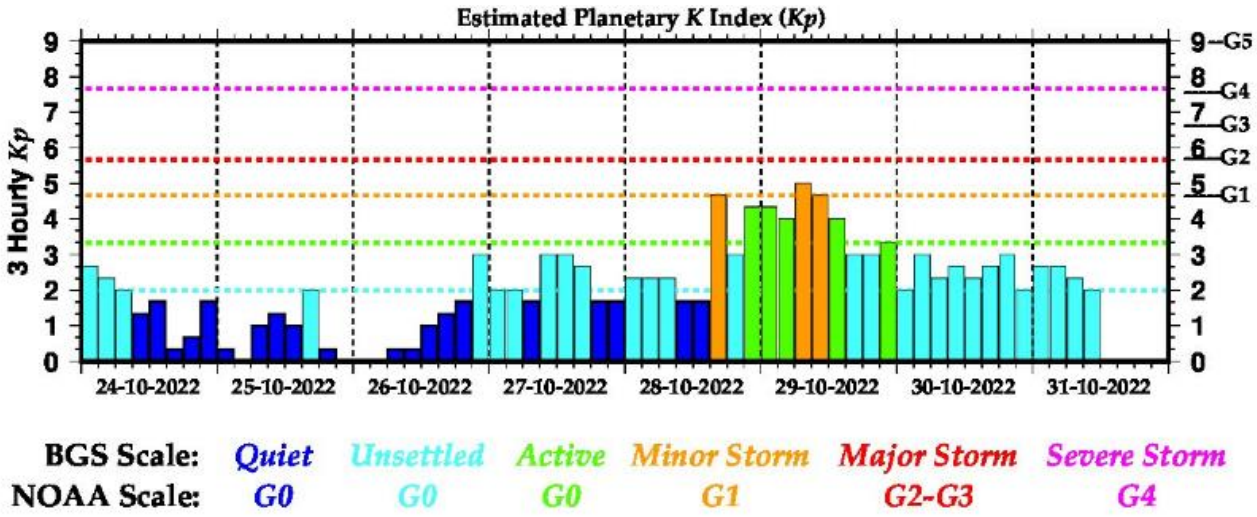
No Earth-directed CMEs are forecast.

The Earth is currently under the influence of the high speed stream from positive coronal hole 37, with current levels around 450km/s and trending downwards. Later on day 1 (31st), Earth will likely transition into CH38, which is a feature within the same system as the previous CH36 and CH37. Based on observations from the last rotation, speeds of around 500-550 km/s were observed. There is a chance that solar wind speeds may peak a little higher to Strong levels (600-650 km/s) for a time, though this is uncertain. Earth will then likely transit out of the fast wind of CH38 early on day 3 (2nd) with a likely decline in wind speeds before the fast wind from CH39 arrives probably late on day 4 (3rd).

Geomagnetic activity will likely be Quiet to Unsettled (Kp 2-3) throughout the period, with a chance of Active or G1/Minor Storm intervals (Kp 4-5) late on day 1 (31st) or late on day 4 (3rd) due to the fast wind arrivals of CH38 and CH39 respectively.

Geo-Magnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	No	30	20	20	30
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2: BGS estimated planetary K index (Kp).



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Radio Blackouts - X-Ray Flares:

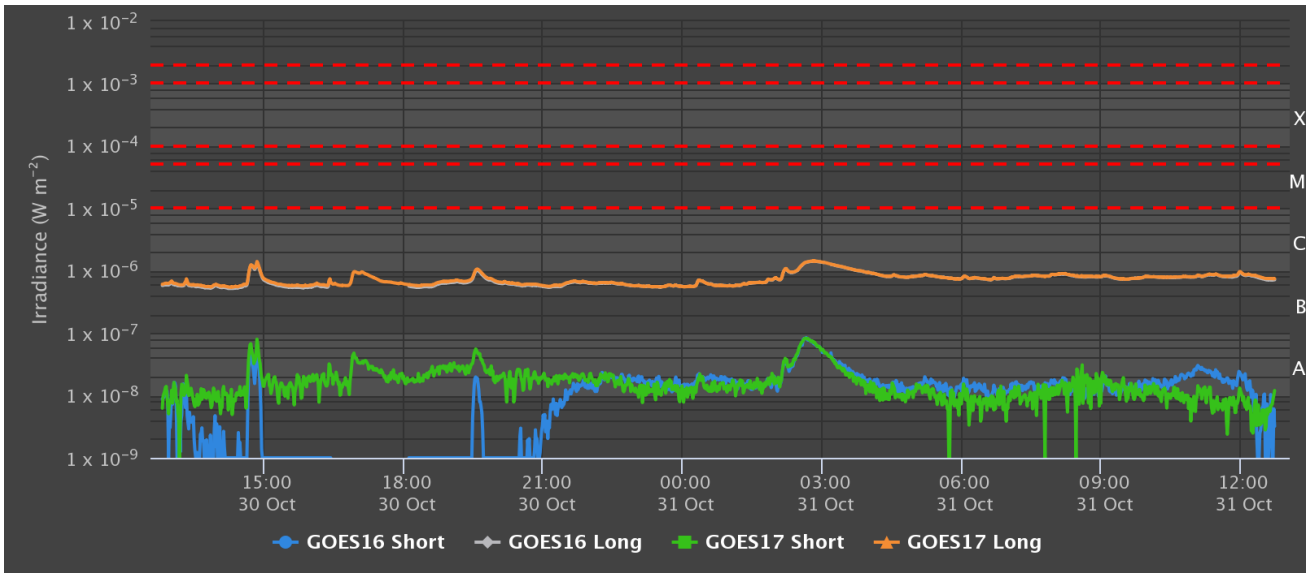
There are three numbered Active Regions on the visible disc. AR3135, is the largest region with well developed leading and trailing spots. AR3131 has simplified to a large single spot, which is now a Hhx/Beta configuration. AR3133 close to centre disc is small and continues to fade.

GONG far-sided imagery indicates a number of regions are forecast to rotate onto the visible disc from across the eastern limb through the forecast period, and this could further increase risk values.

Solar activity is likely to be Low or Very Low, with a slight chance of Moderate activity, mainly concentrated in the developing regions in the northeast quadrant.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	10	15	20	20
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 3: GOES-17 X-Ray Flux



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Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) at GEO, observed by GOES-16 is currently at background and is forecast to remain at this level through the guidance period.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	1	1	1	1
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2MeV) observed by GOES-16 is forecast to be mostly at high levels, especially during the diurnal maximum each day, perhaps dipping just below during the minima.

The associated 24 hour electron fluence is expected to remain above the Active (1e8 integrated pfu) threshold initially and perhaps for some time, though due to the arrival CH38 late on day 1 (31st) then CH39 late on day 4 (3rd) and the natural waning effects of the electron fields, confidence also wanes with time. Recurrence favours the elevated electron flux and fluence values for several days, though persistence shows on previous rotation the Active fluence threshold was not reached. The Met Office REFM output also shows good guidance for Active electron fluence initially, with a waning trend.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	100	80	60	40
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	5	5	5	5

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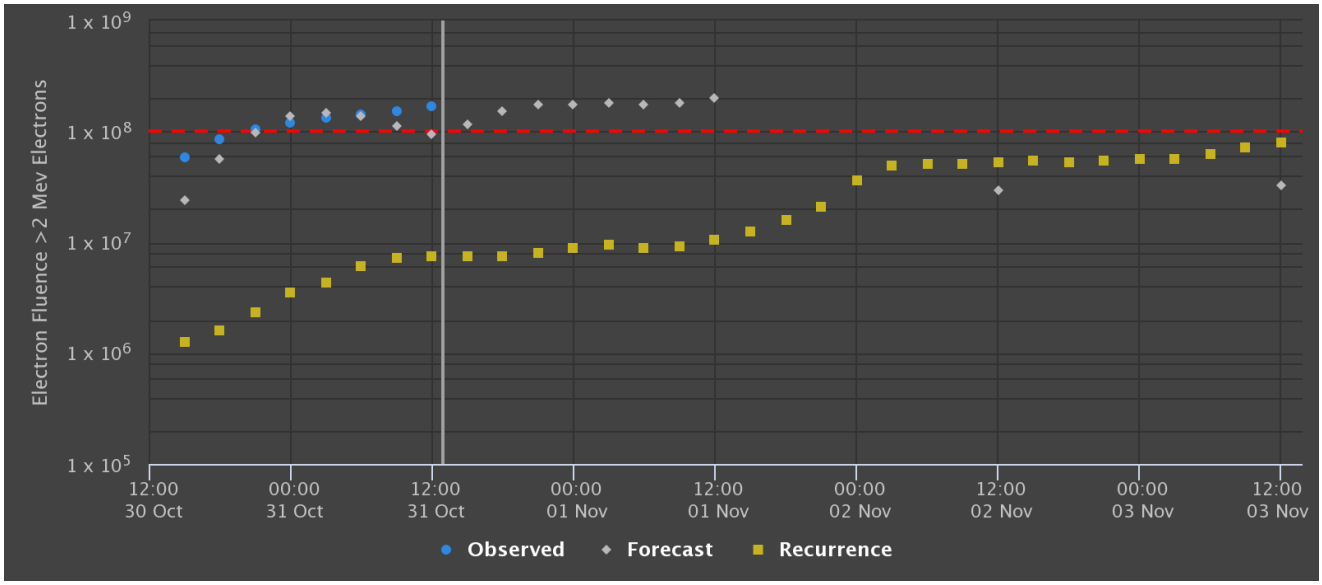
Figure 4: REFM integrated Electron Fluence – forecast, observations and recurrence



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